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From this expression we have to determine the values of W' and W'' that reduce $r_0'^2$ to a minimum; just as (7) was derived from (6). Differentiating, we have

$$4(1+h)\,W' + 2\frac{p_1}{P}\,W'' = F',$$

$$\frac{2p_1}{P}\,W' + \frac{12}{W_0}\,W'' = F'.$$

For computing the numerical values of the coefficients of these equations, we have $h = 2$, and from the reduction of the I, II, III, IV above, $p_1 = 2$, $P = 14$, $W_0 = 2.21$. Solving the equations we obtain $W' / W'' = 0.44$; or $W' = 0.44$, $W'' = 1$. Hence

$$\varphi_0' = 20.'' + \frac{0.44 \times 5''.3 + 2''.87}{1.44} = 23''.61;$$

and from (21), assuming $r_\delta^2 = \frac{2}{3}$, and substituting for the other letters the numbers given above, we have $W_0' = 1 / r_0'^2 = 3.11$ instead of 6.00 as by the ordinary formula. Therefore, as the final result, we have: latitude $= +\,38°16'\,23''.61$ with weight 3.11.

VENABLE'S MODERN GEOMETRY.*

This little manual, prepared as an appendix to Professor Venable's edition of Legendre's Elements of Geometry, is a worthy addition to that excellent text-book. The same judicious arrangement, care in selection of material, accuracy, and completeness of presentation characterize both.

The subjects treated are, in order: Transversals, and some of their applications to the geometry of position, after the methods of Carnot; anharmonic ratios, and the theorems of Pascal and Brianchon for the circle, with applications; harmonic rows and pencils, and the harmonic properties of the complete quadrilateral; poles and polars in the circle; reciprocal polars and the law of duality; radical axes; and axes and centres of similitude.

The treatment is rather metrical than descriptive, so that the learner would get from this manual a quite inadequate conception of the genuine and characteristic methods of the Modern Geometry as expounded by Steiner, von Staudt, Reye, Cremona, and their disciples; or even by Chasles. But in some respects, this alliance with the metrical methods of the Euclidean geometry is to be pre-

* Introduction to Modern Geometry. By Charles S. Venable, LL. D., Professor of Mathematics in the University of Virginia. University Publishing Company: New York, 1887.

ferred for the beginner. The change of intellectual climate is less sudden; the introduction of novel conceptions less bewildering; and the powerful methods of the modern synthesis will be better appreciated for this gradual revelation of their freedom and scope. In a somewhat careful reading no error likely to mislead the student has been found except in the statements as to reciprocal polars in 82 *seq.*, which are entirely wrong, and inconsistent with the correct statements in 77–81. The locus of Q is the *inverse* to the locus of P, not the *reciprocal polar*. And the statement of 83, that the locus in the case of a circle is a conic, is not only wrong, but contradicts the correct statement of 82.

The well-selected exercises are carefully assorted and appended to the appropriate sections, instead of being thrown confusedly to the end of the book. To each exercise are added hints for its solution; these would seem to furnish an amount of help to the learner always ample, perhaps in some cases excessive; a few difficulties might have been left unsolved. [*W. M. T.*]

SOLUTIONS OF EXERCISES.

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FIND the equation to the circle through the feet of the normals from (h, k) to the parabola $y^2 = 2px$.

SOLUTION.

Circle $x^2 + y^2 + 2gx + 2fy + c$ cuts parabola $y^2 - 2px$ in points whose ordinates are roots of

$$y^4 + y^2(4p^2 + 4pg) + 8p^2fy + 4p^2c = 0. \qquad (1)$$

The ordinates of the feet of the normal from (h, k) on $y^2 - 2px$ are roots of

$$y^3 + y(2p^2 - hp) - 2p^2k = 0. \qquad (2)$$

Equations (1) and (2) have three common roots if

$$2f = -\tfrac{1}{2}k, \quad 2g = -p - \tfrac{1}{2}h, \quad c = 0.$$

[*R. D. Bohannan, and others*].